Combo Project 8 Output File Studying and Simulating US (And Other) Electoral College Elections Michael Yen, Tianyi Liu, Zhizhang Deng 12/14/20

1 Probabilities

1.1 Experimental Probability of Democratic Candidate Winning the Electoral Vote Given the Individual Probability of the Candidate Winning Each State is the 2020 Popular Vote Percentage

```
v := [81282896, 74222484];
p := v[1]/(v[1]+v[2]);
WinProb(USEC(),p,1000);
Output:
0.5840000000
```

1.2 Calculated Probability of Democratic Candidate Winning the Electoral Vote Given the Individual Probability of the Candidate Winning Each State is the 2020 Popular Vote Percentage

```
v := [81282896, 74222484]:
p := v[1]/(v[1]+v[2]):
f:=evalf(GFvp(USEC(),p,x)):
evalf(add(coeff(f,x,i),i=270..degree(f,x)));
Output:
0.5896628367
```

1.3 Experimental Probability of Democratic Candidate Winning the Electoral Vote Using (Recent) Historical Data

```
WinProbInformed(USEC2(),1000);
```

Output: 0.5560000000

1.4 Calculated Probability of Democratic Candidate Winning the Electoral Vote Using (Recent) Historical Data

```
f:=evalf(GFvp2(USEC2(),x)):
evalf(add(coeff(f,x,i),i=270..degree(f,x)));
0.5613012890
```

2 Averages

2.1 Experimental Average Number of Electoral Votes for Democratic Candidate Using Only 2020 Popular Vote as Individual Probability of the Candidate Winning Each State

```
v := [81282896, 74222484];
p:=v[1]/(v[1]+v[2]);
s1:=SimuCount(USEC(),p,1000,4);
[281.4120000, 49.75313314, -0.03161792474, 2.712346039], 0.1530000000
```

2.2 Experimental Average Number of Electoral Votes for Democratic Candidate Using (Recent) Historical Data

```
s2:=SimuCountInformed(USEC2(),1000,4);
[274.4650000, 25.34736229, 0.06630275564, 2.907743535], 0.08900000000
```

2.3 Calculated Expected Average Number of Electoral Votes for Democratic Candidate Using Only 2020 Popular Vote Individual Probability of the Candidate Winning Each State

```
v := [81282896, 74222484]:
p:=v[1]/(v[1]+v[2]):
s1:=evalf(StatAnal(GFvp(USEC(),p,x),x,10)):
s1[1];
281.2134091
```

2.4 Calculated Expected Average Number of Electoral Votes for Democratic Candidate Using (Recent) Historical Data

```
s2:=evalf(StatAnal(GFvp2(USEC2(),x),x,10)):
s2[1];
274.2380952
```

3 (Finite) Sequences

3.1 Sequence for the Number of Ways One of the Candidates can get Exactly i Electoral Votes

```
f:=(GFv(USEC(),x)):
seq(coeff(f,x,i),i=1..degree(f,x));
0, 0, 8, 5, 3, 34, 43, 36, 122, 201, 217, 427, 730, 920, 1434, 2330, 3162,
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```

3.2 Sequence for the Probability of Either Candidate Getting Exactly *i* Votes, Using USEC() and Using Biden's Popular Vote Percentage in 2020 as p

```
v := [81282896, 74222484];
p:=v[1]/(v[1]+v[2]);
f1 := evalf(GFvp(USEC(), p, x));
seq(coeff(f1,x,i),i=1..degree(f1,x));
0, 0, 3.637868801*10^{(-16)}, 2.273668001*10^{(-16)}, 1.364200801*10^{(-16)},
1.667212504*10^{-15}, 2.128380572*10^{-15}, 1.784113138*10^{-15},
6.327781814*10^{(-15)}, 1.065549704*10^{(-14)}, 1.156597235*10^{(-14)},
2.336625882*10^{-14}, 4.091855453*10^{-14}, 5.212827776*10^{-14},
8.283821011*10^{-14}, 1.375117597*10^{-13}, 1.891804349*10^{-13},
2.741423846*10^{(-13)}, 4.229581688*10^{(-13)}, 5.964529940*10^{(-13)},
8.355816723*10^{-13}, 1.214407356*10^{-12}, 1.704465321*10^{-12},
2.347971690*10^{(-12)}, 3.279752711*10^{(-12)}, 4.522784626*10^{(-12)},
6.144833815*10^{(-12)}, 8.358955482*10^{(-12)}, 1.129973542*10^{(-11)},
1.513266363*10^{(-11)}, 2.019079275*10^{(-11)}, 2.680343319*10^{(-11)},
3.536301472*10^{(-11)}, 4.644631296*10^{(-11)}, 6.069394846*10^{(-11)},
7.893687723*10^{-11}, 1.022345581*10^{-10}, 1.317691476*10^{-10},
1.691250679*10^{-10}, 2.162524118*10^{-10}, 2.753105422*10^{-10},
3.491213111*10^{(-10)}, 4.411863451*10^{(-10)}, 5.553710004*10^{(-10)},
6.965556582*10^{(-10)}, 8.707677463*10^{(-10)}, 1.084765790*10^{(-9)},
1.346809312*10^{(-9)}, 1.666949894*10^{(-9)}, 2.056635303*10^{(-9)},
2.529541044*10^{(-9)}, 3.102055450*10^{(-9)}, 3.792939655*10^{(-9)},
4.624378458*10^{(-9)}, 5.622496334*10^{(-9)}, 6.817228638*10^{(-9)},
8.243712019*10^{(-9)}, 9.942799058*10^{(-9)}, 1.196112490*10^{(-8)},
1.435302840*10^{(-8)}, 1.718119211*10^{(-8)}, 2.051669327*10^{(-8)},
2.444179483*10^{-8}, 2.905075157*10^{-8}, 3.444983622*10^{-8},
4.076100707*10^{-8}, 4.812328693*10^{-8}, 5.669268323*10^{-8},
6.664659460*10^{(-8)}, 7.818620498*10^{(-8)}, 9.153640179*10^{(-8)},
1.069508525*10^{(-7)}, 1.247153661*10^{(-7)}, 1.451484741*10^{(-7)},
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1.686069050*10^{(-7)}, 1.954898401*10^{(-7)}, 2.262406625*10^{(-7)},
2.613530723*10^{(-7)}, 3.013757964*10^{(-7)}, 3.469156614*10^{(-7)},
3.986452502*10^{(-7)}, 4.573074977*10^{(-7)}, 5.237199839*10^{(-7)},
5.987846866*10^{(-7)}, 6.834927944*10^{(-7)}, 7.789295340*10^{(-7)},
8.862863864*10^{(-7)}, 1.006866726*10^{(-6)}, 1.142090610*10^{(-6)},
1.293509356*10^{(-6)}, 1.462812496*10^{(-6)}, 1.651832811*10^{(-6)},
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0.0002315778282, 0.0002168590239, 0.0002028943060,
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0.0001540509010, 0.0001434647399, 0.0001334778621,
0.0001240655879, 0.0001152036761, 0.0001068683352,
0.00009903622533, 0.00009168453344, 0.00008479096381,
0.00007833374201, 0.00007229168697, 0.00006664418709,
0.00006137119663, 0.00005645330753, 0.00005187171738,
0.00004760821584, 0.00004364524921, 0.00003996588670,
0.00003655380287, 0.00003339332836, 0.00003046941434,
0.00002776761452, 0.00002527412486, 0.00002297574265,
0.00002085985076, 0.00001891444971, 0.00001712810734,
0.00001548994753, 0.00001398967824, 0.00001261753419,
0.00001136426308, 0.00001022115520, 9.179983220*10^{-6},
8.232982147*10^{-6}, 7.372881846*10^{-6}, 6.592846955*10^{-6},
5.886451606*10^{(-6)}, 5.247708973*10^{(-6)}, 4.671021680*10^{(-6)},
4.151149243*10^{(-6)}, 3.683230521*10^{(-6)}, 3.262746384*10^{(-6)},
2.885487270*10^{(-6)}, 2.547564920*10^{(-6)}, 2.245381779*10^{(-6)},
1.975609092*10^{(-6)}, 1.735184668*10^{(-6)}, 1.521286459*10^{(-6)},
1.331322017*10^{-6}, 1.162920766*10^{-6}, 1.013902848*10^{-6},
8.822788416*10^{(-7)}, 7.662456522*10^{(-7)}, 6.641476219*10^{(-7)},
5.744821085*10^{(-7)}, 4.959000364*10^{(-7)}, 4.271673763*10^{(-7)},
3.671673251*10^{-7}, 3.149077619*10^{-7}, 2.694861598*10^{-7},
2.300876638*10^{(-7)}, 1.959951440*10^{(-7)}, 1.665601175*10^{(-7)},
1.412008869*10^{(-7)}, 1.194083968*10^{(-7)}, 1.007251883*10^{(-7)},
8.474408064*10^{(-8)}, 7.111214913*10^{(-8)}, 5.951228296*10^{(-8)},
4.966513425*10^{(-8)}, 4.133229405*10^{(-8)}, 3.429794526*10^{(-8)},
2.837425087*10^{-8}, 2.340428273*10^{-8}, 1.924513673*10^{-8},
1.577209883*10^{-8}, 1.288489749*10^{-8}, 1.049166601*10^{-8},
8.511149651*10^{(-9)}, 6.880732029*10^{(-9)}, 5.543377073*10^{(-9)},
4.447608308*10^{(-9)}, 3.554535156*10^{(-9)}, 2.830461958*10^{(-9)},
2.243942549*10^{(-9)}, 1.770944873*10^{(-9)}, 1.391873529*10^{(-9)},
1.089116150*10^{(-9)}, 8.479545473*10^{(-10)}, 6.565157083*10^{(-10)},
5.062378748*10^{-10}, 3.885898840*10^{-10}, 2.956924590*10^{-10},
2.239493370*10^{-10}, 1.695748625*10^{-10}, 1.265964531*10^{-10},
9.353504042*10^{-11}, 6.991594776*10^{-11}, 5.130807399*10^{-11},
3.653955719*10^{-11}, 2.688058705*10^{-11}, 1.962180912*10^{-11},
1.321754341*10^{(-11)}, 9.422708386*10^{(-12)}, 7.036364037*10^{(-12)},
4.421468018*10^{(-12)}, 2.892109389*10^{(-12)}, 2.319612029*10^{(-12)},
1.388698216*10^{(-12)}, 7.241004765*10^{(-13)}, 6.744976234*10^{(-13)},
4.185621743*10^{-13}, 1.290046751*10^{-13}, 1.542961360*10^{-13},
```

```
1.232317643*10^{(-13)}, 1.171113008*10^{(-14)}, 1.951855014*10^{(-14)}, 3.122968023*10^{(-14)}, 0, 0, 4.275050350*10^{(-15)}
```

3.3 Sequence for the Probability of Either Candidate Getting Exactly i Votes, Using USEC2()

```
f2 := evalf(GFvp2(USEC2(), x));
seq(coeff(f2,x,i),i=1..degree(f2,x));
0.0001584557463, 0.0001584557463, 0.0002426353615, 0, 0, 0.0002735248002,
0.0005545951120, 0.0003703764559, 0.0001061529707, 0.0001749615532,
0.0004225486568, 0.0009366179730, 0.0009763969676, 0.0003634336288,
0.0002923885795, 0.0008928462550, 0.001541062601, 0.001498052895,
0.001120665270, 0.0006654725814, 0.001225703742, 0.002350218159,
0.002563503286, 0.001795212999, 0.001421930271, 0.002108616255,
0.003303911016, 0.003827907045, 0.002976724822, 0.002436928407,
0.003315418085, 0.004832396921, 0.005351670627, 0.004403079104,
0.003809650569, 0.004915217728, 0.005937619668, 0.007282730446,
0.005935955877, 0.005634155650, 0.006060189953, 0.008350705253,
0.008313896364, 0.008172453862, 0.007560625099, 0.008052672851,
0.009862119832, 0.01046379571, 0.01045045151, 0.008943785795,
0.01082313679, 0.01123800869, 0.01204557266, 0.01195934290,
0.01141976839, 0.01218336118, 0.01257457797, 0.01409347170,
0.01193138875, 0.01390494587, 0.01376761735, 0.01465821537,
0.01366995235, 0.01390858452, 0.01435924335, 0.01483151357,
0.01673369692, 0.01336451717, 0.01486492473, 0.01382033160,
0.01671962612, 0.01532379801, 0.01536401921, 0.01356800152,
0.01417331996, 0.01641718934, 0.01535473257, 0.01549838930,
0.01278504018, 0.01478161519, 0.01411152129, 0.01593008840,
0.01396821122, 0.01291094432, 0.01336763267, 0.01309974560,
0.01468117425, 0.01216257522, 0.01305010223, 0.01118963779,
0.01286892412, 0.01170355531, 0.01192553940, 0.01096767842,
0.01067101962, 0.01142696864, 0.009523873928, 0.01074500510,
0.008864163713, 0.01023851082, 0.008677138026, 0.009067120690,
0.007765093431, 0.008054953172, 0.008306401077, 0.007452743535,
0.007417529884, 0.006023043601, 0.006975592228, 0.006030444458,
0.006807664614, 0.005369267524, 0.005082718447, 0.005091790565,
```

```
0.004975963334, 0.005135306332, 0.004105964660, 0.004153937461,
0.003281062026, 0.004141367107, 0.003469324638, 0.003447546058,
0.002756946204, 0.002690319964, 0.002777201194, 0.002466294013,
0.002592107116, 0.001816690133, 0.002095842147, 0.001666656093,
0.001900730828, 0.001471007295, 0.001496663775, 0.001231622305,
0.001210481955, 0.001174779930, 0.0009195877548, 0.001034786870,
0.0007473027339, 0.0008556637373, 0.0006261783690, 0.0006520909143,
0.0005287008696, 0.0005571399201, 0.0004773801620, 0.0003760136449,
0.0003590899668, 0.0002770226088, 0.0003531918372, 0.0002430249243,
0.0002575939456, 0.0001446491535, 0.0001755400376, 0.0001719956197,
0.0001577405269, 0.0001291956087, 0.00007317721636, 0.00008723773410,
0.00007161755100, 0.0001024464199, 0.00004559285637, 0.00005148842056,
0.00002193043512, 0.00004256944381, 0.00003794895521, 0.00003147962937,
0.00001819554444, 7.873457830*10^{-6}, 0.00002042887981, 0.00001377509558,
0.00001922623143, 4.144023420*10^{(-6)}, 5.758298016*10^{(-6)},
2.190948312*10^{-6}, 9.803905578*10^{-6}, 4.395223375*10^{-6},
3.695664076*10^{(-6)}, 9.709037037*10^{(-7)}, 3.499160033*10^{(-7)},
3.094106289*10^{\circ}(-6), 1.530124112*10^{\circ}(-6), 1.861364906*10^{\circ}(-6),
1.392205768*10^{(-7)}, 2.635246632*10^{(-7)}, 1.039080690*10^{(-7)},
1.412094422*10^{(-6)}, 1.988865383*10^{(-7)}, 1.802409253*10^{(-7)},
0, 0, 1.818391207*10^{(-7)}, 6.961028840*10^{(-8)}, 6.961028840*10^{(-8)},
0, 0, 0, 7.955461532*10^{-8}
```